The SPISE Advice for functional inspection of seed treatment equipment

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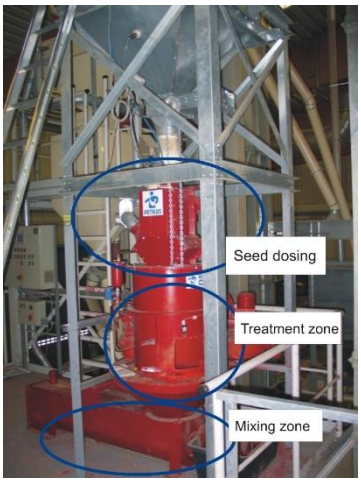
Summary

The new SPISE Advice for the inspection of seed treatment equipment (STE) which deals with requirements for mobile and stationary equipment will be presented. As there are no European or international standards for these types of devices available up to now, the requirements had to be developed first. For mobile seed treatment equipment such as equipment on potato planters the requirements are strongly based on comparable requirements for sprayers in use, EN ISO 16122-series. For stationary systems special requirements apply. Seed treatment equipment is relative to field spraying used in minor scale. According to Directive 128/2009/EU Article 8, 3.a, it could be possible for Member States to apply a different timetables and inspection intervals for such equipment. E.g. equipment for laboratory use or industrial use already engaged in quality assurance systems could be situations where such exemptions could be regarded. For Germany it is planned, to exempt STE with a batch weight of less than 5 kg from the inspection.

In the course of the processing of the requirements, various companies and groups were involved in the discussion, e.g. STE manufacturers SUET, Niklas, Petkus, SATEC, Grimme, plant protection product (PPP) manufacturers like BAYER, SYNGENTA, ADAMA and BASF and other groups e.g. UNIKA (union of the German potato industry).



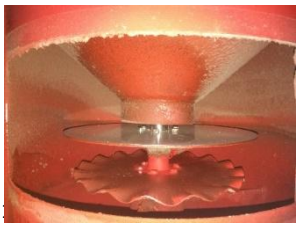
Pic. 1: Prinziple for continuous seed treatment equipment included in inspection process: Seed dosing, treatment zone, mixing chamber.

The Advice is divided into general requirements (before inspection and during the inspection), test methods and test report.

First, it is important to define the devices to be controlled, e.g. which equipment belongs to the STE and which equipment is part of the machinery which are used to prepare and transport the seed to the STE and after treatment transport to the bagging station. As STE are in this sense regarded all parts which coming into direct contact with the treatment liquid such e.g. hoses, lines and pumps from the PPP-container (or separate mixing container) to the spray and mixing chamber, the treatment zone, post-mixing device(s), seed and liquid dosing systems and provided mixing container. Not included in the inspection are parts of facilities before or after the seed treatment process such as fans for aspirators, augers or conveyer for transport of seeds, balances for weighing seeds packages as well as storage for plant protection products.

In the following some seed treatment equipment are presented.

1. Continuous treatment: stationary equipment for cereals: Rotary atomizer followed by mixing auger in mixing chamber



Pic. 2: Rotary atomizer in a continuous seed treatment system.

Pic. 3: Mixing chamber

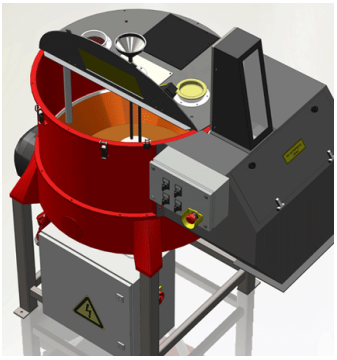
2. Semistationary equipment for treatment of potatoes, transport conveyer with rotary atomizer under hood.

Pic. 4 and 5: Rotary atomizer under a hood

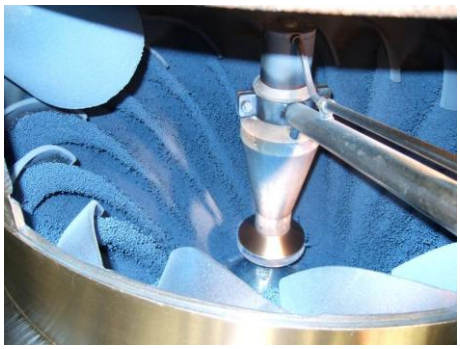
3. Continous treatment in auger: "eg Transmix"

Pic. 6: Continuous treatment in auger like "Trans-Mix"

4. Batch seed treatment principle



Pic. 7 (left): Mixing chamber (rotating drum, cone with funnel for manual dosing or automatic dosing and introduction of PPP. Picture from SATEC (Germany).



Pic. 8 right): Mixing chamber with rape seed with introduction of PPP via pump to a rotating disc atomizer

5. Mobile spraying on seeds

Pic. 9: Mobile spraying on seeds: Potatoe planter with nozzle between hopper and soil

Not regarded as STE in Spise Advice are bandspraying equipment like spraying on potatoes laying in soil or on soil. Memberstates have different principles of what should be regarded as sprayers or as seed treatment equipment. E.g. Germany will regard Rotary atomizer under hood (pic 5) as a sprayer and thus inspected according to EN-ISO 16122-2.
The Spise Advice for seed treatment equipment is to be used for functional inspection of equipment for seed treatment in professional use. This means equipment for applying plant protection products (PPP) in liquid form on seeds to prevent or treat diseases. For seed treatment equipment using PPP in solid form as powders, applicable parts of this Spise Advice can be used together with applicable parts of Spise Advice for granular spreaders.
In the following the requirements and test methods for seed treatment equipment are given. Due to the very different equipment (stationary devices and mobile devices on seeders or potato planters) not every requirement may apply. In such cases, a note should be included in the test report.

Requirements and method of verification

General:
As Some of the tests could lead to a hazardous situation, any inspector performing tests in accordance with this standard should be appropriately trained in the type of work to be carried out. National or local regulations regarding health and safety may apply e.g. on availability of personal protective equipment. As the inspections are carried out in contaminated environment, it is important that the inspector wears appropriate protective clothings.
The operator of the equipment should be present at the inspection. Visible and other known faults should be repaired before the inspection start.
All necessary inspection equipment shall be checked at regular intervals with certified equipment according to national or local regulations. Proof of results of checks shall be available.

Place for inspection
The inspection shall be made in a location avoiding any risk of pollution of environment, this means that at least the sprayed/leaked liquid shall be collected and transferred back into the equipment´s tank at the end of the test.

Inspection materials
All inspection measurements shall be carried out without seed and with water as substitute for PPP. Provided that the dosage should still be checked with seeds and chemicals, it shall be possible to collect the material separately and without treating any seed e.g. by collecting before treatment zone in the equipment.

1. Pre-Inspection
1.1 General. A preliminary inspection shall be carried out so that the inspection can not be continued because of heavy contamination, incrustations etc. and incidents that could result in either injury or damage to the health of the inspector.

1.2 Cleaning. The seed treatment equipment shall be cleaned in order to be able to perform the inspection without risks for the inspector. Cleaning shall include internal parts including present filters, filter inserts and external parts giving special consideration to areas of contamination to which the inspector could be exposed during the inspection.
Method of verification: visual check.

1.3 Unintended discharge of PPP during operation shall be prevented. PPP containers (original containers) shall be placed so that spillage is collected.
Method of verification: visual check.

1.4 Moving parts and power transmission parts. Power transmission parts s.a. rotating shafts, chains, belts etc driven by mechanical, hydraulic or electrical means shall be protected to necessary level. All guards provided for protection of the operator shall be present and be functioning correctly. Where possible or when not required for the function of the equipment, all access to other moving parts shall be prevented by specific safety devices to prevent any risk to the inspector.
Method of verification: visual check.

1.5 Pipes and hoses for hydraulic transmission. If present, there shall be no visible leakage from the hydraulic system. Hydraulic hoses shall not show excessive bending and abrasion through contact with surrounding surfaces. They shall be free from defects such as excessive surface wear, cuts or cracks. Hydraulic pipes shall be retained in position and be free of significant corrosion or damage.
Method of verification: visual check.

1.6 Electric power transmission. If present, electrical connections for electrical drive (connectors, cables) shall be free from bruises, cracks, deformations or exposed wires.
Method of verification: visual check.

1.7 Structural parts and framework. All structural parts and the framework shall be in good condition, without permanent deformations, significant corrosion or other defects which could affect the rigidity or the strength of the equipment.
Method of verification: visual check.

1.8 Lockable foldable parts. Locking of foldable parts of the equipment shall secure these parts in their intended positions.
Method of verification: visual check.

1.9 Blower/fan. If provided, on the seed treatment equipment (e.g. aspiration), the blower (fan, casing, air deflectors) shall be in good condition and mounted in a functional manner. Inspection shall verify in particular that:
- blades are not missing or damaged;
- all parts are free of mechanical deformation, excessive wear, corrosion sufficient to interfere with safe operation and significant vibration;
- guarding to prevent access to the fan is present.
- the blower shall work properly at the nominal working range of PTO speed, e.g. no vibrations due to imbalance, no friction between the body and the fan or wrong orientation of the blades.

Method of verification: inspection.

2. Requirements

2.1 Leaks

2.1.1 Static leaks. For spraying equipment equipped with a tank or mixing container, the tank should be filled to its nominal capacity.
With the pump not running and a visual inspection to determine any leakage from all part of the machine (tank, pump and associated pipes…) shall be carried out. No leakage is allowed.
Method of verification: visual check.

2.1.2 Pump leakage. There shall be no leakages (e.g. dripping) from any parts of the pump while pumping clean water at its normally used rotation frequency. For equipment not equipped with a tank, water is pumped from an external container or tank.
Method of verification: visual check and function test

2.1.3 Lines leakage. There shall be no visible leakage from pipes or hoses including their coupling when used at the normally flow for the system.

Method of verification: visual check and function test

2.2 Pump(s)
2.2.1 Capacity. The pump capacity shall be suited to the needs of the equipment.
Method of verification: visual check

2.2.2 Air chamber. If an air chamber is present, the air pressure shall be the pressure recommended by the equipment manufacturer or from 30 % to 70 % of the working pressure.
The membrane shall not be damaged (no liquid shall appear when testing the air valve).
Method of verification: function test and measurement.

2.3 Spray mix agitation (in case of a present tank or mixing container). A clearly visible agitation shall be maintained when the agitation system is working as recommended by the manufacturer, with the tank or mixing container filled to half its nominal capacity. For hydraulic agitators, the following specifications apply:
- operate at the maximum working pressure of the spraying equipment,
- use the largest nozzles and all nozzles mounted on the spraying equipment are in use,
- pump rotation frequency as recommended by the manufacturer,
- with the tank filled to half its nominal volume.
Method of verification: visual check.

2.4 Mixing tank or tank for spray liquid. There shall be a pressure compensation device to avoid over-pressure and under-pressure in the tank. If present, the tank shall be provided with a lid that shall be well adapted and in good condition, free of deformations, holes etc. This lid shall be tightly sealed to avoid unexpected opening and lose.
If present, the tank-emptying valve shall operate reliable and it shall be possible to collect the tank content without contamination of the operator or environment.
Method of verification: visual check.

2.5 Mixing device for continuous seed treatment equipment. If a mixing device is present: The state of the mixing device shall be in good condition to assure its correct functioning.
Note: The condition of the components of a mixing device such as a brush, auger or paddle shall be checked. The function of the mixing device shall be noted.
Method of verification: visual check.

2.6 Cleaning
2.6.1 Cleaning device for plant protection product container. If provided, the cleaning device for plant protection product container shall work properly.
Method of verification: function test.

2.6.2 Cleaning equipment. If present, tank cleaning device, device for external cleaning and device for cleaning of additional equipment s. a. induction hopper, and devices for internal cleaning of complete equipment shall work properly.
Method of verification: visual check and function test.

2.7 Measuring systems, controls and regulation systems
2.7.1 General. It shall be possible to collect the operated seeds and PPP independently to determine the amounts in order to check the dose rate. For continuous seed treatment equipment the flow of seed or PPP shall automatically stop if one or the other is interrupted.
All devices for measuring and/or adjusting the pressure and/or flow rate shall operate properly. The valves for switching on or off the spray shall operate properly.
Method of verification: visual check and function test.

2.7.2 Controls. All controls shall operate reliably and be able to be operated from the operator's position during operation. Instrument displays shall be readable.
Method of verification: visual check, function check.

2.7.3 Scale of pressure indicator. Digital or analogue pressure indicator used for the dosing of PPP, if present, shall be clearly readable from the operator's position and suitable for the working pressure range used.
NOTE: For analogue pressure indicators the recommended minimum diameter is generally 63 mm.
Method of verification: visual check.

The scale of **analogue pressure indicators** shall provide graduations:
• at least every 0.2 bar for working pressures less than 5 bar;
• at least every 1.0 bar for working pressures between 5 bar and 20 bar;
•at least every 2.0 bar for working pressures more than 20 bar.
Method of verification: visual check.

2.7.4 Accuracy of pressure indicator. The accuracy of the pressure indicator shall be
• ± 0.2 bar for working pressures at 2 bar and below,
•± 10 % of the real value for pressures at 2 bar and above.
Method of verification: according to 3.3.

2.7.5 Pressure or flow adjusting devices. All devices for adjusting pressure or flow shall maintain a constant pressure or flow with a tolerance of 10 % at constant setting. Pressure or flow shall return to the original working pressure or flow ±10 % after the equipment has been switched off and on again.
NOTE: The inspection is not possible on equipment where seed and PPP flow must run at the same time and cannot be shut off individually.
Method of verification: function test and measurement according to 3.3.3 and 3.3.4.

2.7.6 Other measuring devices. Other measuring devices especially flow meters and forward speed sensors used for controlling the volume rate, shall measure within a maximum error of ± 5 % of the value read on the reference instrument within the range of the measuring device.
Method of verification: measurement according to 3.4.2.

2.8 Lines (pipes and hoses)
2.8.1 Bending / abrasion. Hoses shall not show excessive bending and abrasion through contact with surrounding surfaces. They shall be free from defects such as excessive surface wear, cuts or cracks. They shall be mounted in a way to avoid blockage or damages.
Method of verification: visual check.

2.9 Filtering
2.9.1 Filters presence. If present, filter(s) shall be in good condition and the mesh size shall correspond to the nozzles fitted according to the instructions of nozzle manufacturers.
Method of verification: examination of specification and visual check.

2.9.2 Filter inserts changeability. Filter inserts shall be changeable in accordance with the equipment manufacturers' instructions. Method of verification: visual check and function test.

2.10 Application units
2.10.1 Stability. Holders for nozzles or atomizers, if present, shall be stable in all directions, i.e. no excessive movement and not be bent.
Method of verification: visual check.

2.10.2 Nozzle /atomizer spacing / orientation. It shall not be possible to modify unintentionally the position and direction of the nozzles in working conditions.
It shall be possible to collect flow from nozzles or atomizers for measurement and calibration.
Method of verification: visual check.

2.11 Nozzles / atomizers
2.11.1 General. The atomizers for PPP shall not be affected in their function e. g. by encrustations or dirt.
Method of verification: visual check.

2.11.2 Dripping. After being switched off there shall be no continuous dripping after the liquid flow has been shut off.
NOTE: Dripping may occur for a maximum of 5 seconds after the liquid flow has been shut off.
Method of verification: visual check.

2.11.3 Flowrate.
Nominal nozzle-/ atomizer flow rate known:
The deviation of the flow rate of each nozzle shall not exceed 10 % of the nominal flow rate at the working pressure.
Method of verification: measurement according to 3.4.

Nominal nozzle flow rate unknown:
The flow rate of a single nozzle/atomizer shall not exceed ± 10 % of the average flow rate of the nozzles/atomizers of the same type mounted on the equipment.
In case of only two nozzles of a same type and size, the average value is not considered but the deviation between the two nozzle.
In case of only one nozzle, a measurement is performed at a normally used setting to give the operator information about flow.
Method of verification: measurement according to 3.4.

2.12 Chemical dosing system
Dosing systems shall:
- not leak;
- have no backflow leakage though the chemical pathway or water inlet of the dosing unit;
- Setting of dose adjustment shall be clearly readable.

Method of verification: inspection, function test.

2.13 Other electronic devices. When provided, shall work properly. Examples of equipment are level indicators, level control, level switches, flow control, flow switches
Method of verification: visual check and function test.

2.14 Other equipment. When provided shall function according to original design and shall not be influenced by wear and damages.
Method of verification: visual check and function test.

3 Test methods

3.1 Pump capacity test (optional)
3.1.1 Test method. The pump capacity shall be measured using the following procedure:
a) On equipment not fitted with a test adapter, when the pump capacity is not given by equipment manufacturer for the pump mounted on the equipment or for pumps for which the maximum working pressure is not known, a calibrated pressure indicator shall be placed at an end nozzle and the

maximum working pressure recommended by the equipment manufacturer or the nozzle manufacturer during test shall be established and used.
b) The tank shall be filled with clean water to half its nominal volume. A correct and clean filter shall be placed on suction side of the pump in accordance with the equipment manufacturer's instructions.
All connections shall work properly without leakage at maximum operating pressure and without air inlet.
Connect the measuring device as close as possible to the pump outlet or at a position provided by the equipment manufacturer.
In case of multiple pumps with separate outlets, one for agitation and one for nozzles, the measuring device shall be connected according to the equipment manufacturer's instructions, either on each outlet separately or to both outlets connected together.
Water discharged from the measuring device shall be fed back into the main tank or mixing tank. The pump shall be operated at the nominal rotation speed given by the pump manufacturer. Pumps with variable flow, driven by wheels, shall be operated according to the instructions given by the manufacturer.
The flow shall be measured at free outlet at one pressure between 8 (± 0.2) bar and 10 (± 0.2) bar, or if lower at the highest permitted working pressure for the pump.

3.1.2 Test equipment. The error of the flow meter shall not exceed 2 % of the measured value when the capacity of the pump is >100 l min-1 and 2 l min-1 when the capacity of the pump is
< 100 l min-1. The flow measuring device shall have a transparent part to identify air leakages on the pumps suction side.

3.2 Pump pulsations. Pulsations shall be checked:
- with nominal rotation speed of the pump;
- at the location of the equipments pressure indicator (with the calibrated test pressure indicator).

3.3 Verification of pressure indicators
3.3.1 Specifications of pressure indicators used for verification
Analogue pressure indicators used for testing shall have a minimum diameter of 100 mm and shall be damped. Other minimum requirements on pressure indicators used for testing are given in Tab. 1.

Tab. 1 – Characterization of pressure gauge used for testing in accordance with EN 837-1

Pressure to measure △p (bar)	Scale unit max. (bar)	Accuracy (bar)	Class required	Scale end value (bar)
0<△p≤6	0,1	0,1	1,6	6
			1,0	10
			0,6	16
6<△p≤16	0,2	0,25	1,6	16
			1,0	25
△>16	1	1	2,5	40
			1,6	60
			1,0	100
1 bar = 0.1 MPa = 0.1 N/mm^2 = 10^5 N/m^2				
Source: EN ISO 16122-2:2015				

3.3.2 Verification method of the pressure indicator. The pressure indicator shall be tested mounted on the equipment or on a test bench. Measurements shall be carried out with both increasing and decreasing pressures in each case as a minimum at 4 equally spaced points within the relevant working pressure range.
The measurements require a stable pressure (no pump pulsations).

3.3.3 Measurement of the pressure variation when the spray is switched off. Pressure variation shall be checked at the location of the equipments pressure indicator. The variation of the value indicated by the calibrated test pressure indicator is observed and recorded when the spray is switched off and on again. The pressure shall be observed 10 s after spray is shut off.

3.3.4 Measurement of flow variation when the spray is switched off. Flow variation shall be measured by measuring flow as described in 3.4.2 two times; first during spraying and second after the spraying has been shut off and then on again. The measured values are compared to each other.

3.4 Measurement of the flow rate of the spray nozzles / atomizers
3.4.1 General. This test may be performed with nozzles mounted on the equipment or removed from the equipment. It shall be ensured that the spray jets are correctly formed when nozzles are mounted on the boom and before dismounting.
The error in the measured flow shall not exceed 2.5 % of the measured value. The test shall be carried out at a working pressure relevant for the use of the equipment.

3.4.2 Measurement with nozzles fitted on the equipment. Agricultural nozzle:
The flow rate of each nozzle shall be measured according to ISO 5682-2:2017, *8.1, except 8.1.1*.
The measuring device shall have an accuracy of maximum 1 % error of the measured value.

3.4.3 Measurement with nozzles removed from the equipment. Agricultural nozzle:
The measurement of the flow rate of each nozzle shall be carried out on a test bench.
The test bench consists of a pump by which water with a certain pressure can be pumped through the nozzle, a pressure regulator, a pressure indicator (analogue or digital) by which the actual pressure can be monitored and a flow meter by which the actual flow rate can be measured.
The pressure indicator shall meet the requirements in 3.3.1.
The liquid system, adapters, etc. shall not have an influence on the flow rate.

Conclusion

Due to the missing standard for the inspection of used equipment, requirements for seed treatment equipment (STE) have been developed under discussion with equipment manufacturers and associations. Because the design of the devices can be very different, special requirements are required for stationary STE, while the requirements for mobile equipment, mostly used on potato planters or in storage houses for potatoes are based on the existing requirements for sprayers according ISO 16122-2. Due to the very different devices, not every requirement will be applicable.

References

Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides. http://eur-lex.europa.eu/eli/dir/2009/128/2009-11-25
EN ISO 16122-2 Agricultural and forestry machinery – Inspection of sprayers in use – Part 2: Horizontal boom sprayers (ISO 16122-2:2015)
JKI Guideline 1-1.5, Requirements for seed treatment equipment, 04-2013